

An underwater photograph showing several freshwater mussels attached to a dark, textured rock surface. The mussels are of various sizes and orientations, with some showing their characteristic greenish-brown shells and others showing their siphons. The water is clear, and the lighting is bright, highlighting the details of the mussels and the rock.

# **Status of Freshwater Mussels**

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# Objectives

- Legal Basis
- Historic Information
- Current Studies/Surveys
- Basic Biology
- Impact to Species
- Klamath River Study

# Fish and Game Code

Section 45 - "Fish" means wild fish, mollusks, crustaceans, invertebrates, or amphibians, including any part, spawn, or ova thereof.

# Fish and Game Code

**Section 5937** - The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, **to keep in good condition any fish** that may be planted or exist below the dam.

# Clean Water Act

- Clean Water Act was established to protect the chemical, physical, and biological integrity of the nations waters.
- Before the Federal Energy Regulatory Commission can issue a new license for a hydroelectric facility, the operator must obtain water quality certification under section 401 of the act.

# Why Care?

- The United States has the greatest diversity of freshwater mussels in the world. Most live in the Southeast.
- In the US, there are 42 mussels that are listed as federally endangered or threatened and another 70 species have been proposed
- Long lived, some species may live for 100 years.
- Indicators of water quality and impacts. Can impact water quality.
- Sensitive to changes in fish populations and species assemblage.
- Sensitive to hydro modification?
- Historic subsistence food sources for tribes.

# Historic Distribution and Species

- Taylor (1980) described five species in California
- Freshwater Mussels of the Pacific Northwest followed Turgeon et al. (1998), which considers six species of *Anodonta* west of the Continental Divide: *californiensis*, *dejecta*, *nuttalliana*, *oregonensis*, *kennerlyi*, and *beringiana*.
- Ethnographic record/midden sites

# California Floater

*Anodonta californiensis* - The California floater is a federal species of concern. Most natural populations in California have been extirpated, particularly in southern California and most of the Central Valley. It may be nearly extirpated from Arizona, and it is a candidate for protection in Washington.





# Oregon Floater

*Anodonta oregoniensis* - The current range of the Oregon floater is not well understood, much less its taxonomic standing. It is likely affected by the same factors that affect other western *Anodonta*, including water diversion, dams, pollution, and invasive species.

# Western Pearlshell

*Margaritifera falcata* -

The greatest threats to western pearlshells come from water diversion projects for irrigation, power generation, and water supply, particularly in Washington, Oregon, Idaho, and California.



# Western Ridged Mussel

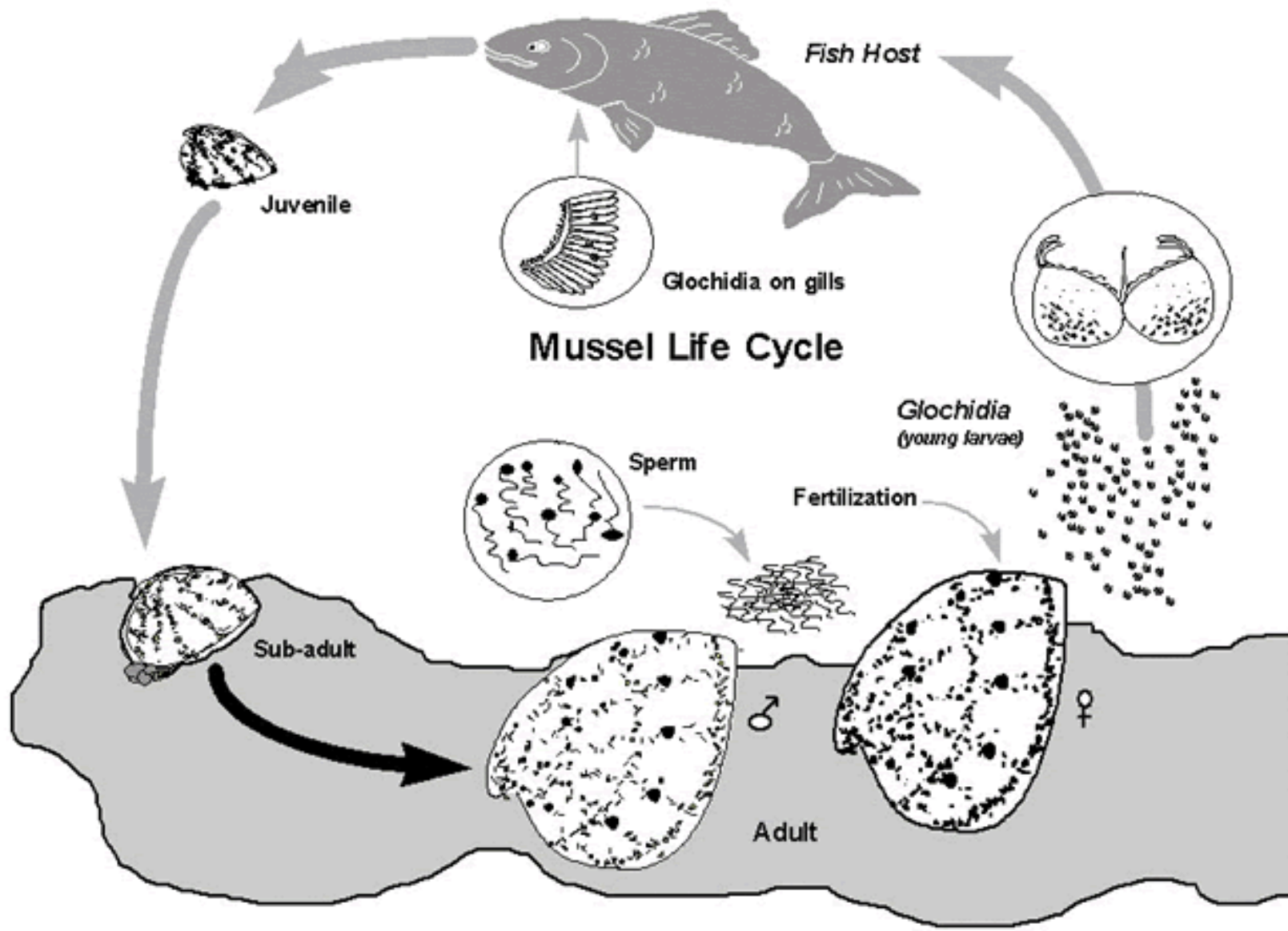
*Gonidea angulata* -

Western ridged mussels have been extirpated throughout their original range in California, particularly in southern California and the Central Valley. They have also been extirpated from many sites in the Snake and Columbia watersheds.



# Threats

- Taylor (1980) identified pollution, lowering of the water table, changes in stream flow or increased flooding, logging, over-grazing, and elimination of fish hosts and threats
- Spring Rivers has not documented reproduction of *M. falcata* in the Pit River
- Long lived – low recruitment



# Current Studies/Surveys

- Incidental observations on the Mokelumne River
- Extensive surveys on the Pit River (PG&E)
- Studies on the Pit River funded by the CEC conducted by Spring Rivers
- Post Cantera spill surveys of the Upper Sacramento and Pit Rivers by Frest and Johannes
- Eel River surveys (Kurt M. Cuffey, "Freshwater mussels in a California North Coast Range river: occurrence, distribution, and controls" (August 30, 2002). *University of California Water Resources Center.*)
- Klamath River surveys (PacifiCorp)

# Klamath River

- Large blooms of *Microcystis aeruginosa* occur in Iron Gate and Copco Reservoirs
- Microcystin toxins are found in very high levels in the reservoirs
- *Microcystis* and microcystin toxin is passed downstream to the Klamath River below Iron Gate Dam
- Impacts to aquatic species is not known

# Iron Gate Reservoir



Photo from Thomas B. Dunklin, August 26, 2007



# Iron Gate Reservoir



Photo from Thomas B. Dunklin, August 26, 2007

# Klamath River September 2007



# Klamath River Algal Toxins

- Received a grant from USEPA to study accumulation of algal toxins in tissues
- All lab work is being done by the DFG WPCL using LC-MS/MS
- Tested yearling salmon from the Iron Gate Hatchery
- Tested yellow perch from Iron Gate and Copco Reservoirs
- Tested mussels from the Klamath River below Iron Gate Dam

Samples were collected at several locations in the Klamath River by Kari Norgaard.

*Gonidea angulata* Collected by Kari Norgaard on Klamath River near Interstate 5 bridge July 11, 2007



# Preliminary Results

<i>Species</i>	<i>Location</i>	<i>Concentration Total</i>
G. Angulata	I 5 Bridge	2803 ppb
G. Angulata	Seiad Valley	413 ppb
	Seiad Valley	383 ppb
G. Angulata	Big Bend	506 ppb
Unknown	Big Bend	201 ppb

# Conclusion

- Complete surveys may result in additional listing under the Endangered Species Act
- Freshwater mussels need additional study
- Are indicators of water quality – should be considered in regulatory processes
- Are impacted by pollution, sediments, changes in fish assemblage (passage), and hydrologic modification

